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Research Article

Comparison of coronal microleakage of three temporary restorative material using dye penetration methods

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ABSTRACT

Determination of the success or failure of root canal therapy can be carried out through an ideal temporary restorative material which is considered as a major factor considering the issue. Temporary restorative material prevents the entry of saliva, fluids, microorganisms, and debris into the root canal space. In addition, they also prevent the escape of intracanal medicaments. The aim of this *in vitro* study was to compare the coronal seal of three temporary filling materials (Cavit-G, zinc oxide eugenol [ZOE], and Intermediate Restorative Material [IRM]) by methylene blue dye penetration test. In this study, 34 extracted with no decay mandibular and maxillary molar teeth were used. The teeth were divided into three groups of 10 teeth and two positive and negative control groups of 4 teeth. In the experimental group, 4 × 4 mm endodontic access cavity was created on the occlusal surface, and in each group, the teeth were filled with Cavit-G, ZOE, and IRM. In the positive control group, access cavity was prepared, but the restorative material was not used. In the negative control group, access cavity was not prepared. Experimental groups (teeth) were placed in normal saline for 2 h and then immersed in methylene blue dye for 1 week. Following which longitudinal sectioning of tooth was done with diamond disc and dye penetration was measured using a periodontal probe. ZOE showed significantly more (micro) leakage than Cavit-G and IRM. No statistically significant difference between Cavit-G and IRM. The findings of this *in vitro* study suggest that Cavit-G and IRM show low microleakage and canal contamination in comparison to ZOE and IRM.

Keywords: Microleakage, dye penetration method, temporary restorative material

Introduction

One of the concerns in day-to-day dental practice in restorative dentistry is coronal microleakage which eventually leads to failure of root canal therapy.[1] Failure usually occurs during temporization period. The pathway of the fluid from the oral cavity into the tooth through the restorative material is known as microleakage.[2] It is of great significance for dentists since it occurs around provisional, temporary restorations.[2,3]Therefore, treated teeth should be restored with permanent restorations as soon as possible to prevent coronal leakage.[4] If permanent restoration is not possible, the choice of temporary restorative material is of importance.[5]

An ideal temporary restorative material can be an important factor which determines the success or failure of root canal therapy. Temporary restorative material prevents the entry of saliva, fluids, microorganisms, and debris into the root canal space. In addition, they also prevent the escape of intracanal medicaments which were placed in root canal system.[6-10]

A temporary restorative material should exhibit minimal or no microleakage and should be easy to manipulate. These properties are of prime importance in endodontic therapy.[11]

Magura *et al.* investigated the saliva penetration rate in root canals obturated with Gutta-percha. They found root canal retreatment must be carried out if permanent restoration is delayed for more than 3 months.[12] Barthel *et al.* tested the sealing ability of Intermediate Restorative Material (IRM), Cavit and glass ionomer in 100 single-rooted teeth by bacterial penetration. Their findings showed that glass ionomer had the better sealing ability.[13]

Access this article online

Website: www.japer.in | **E-ISSN:** 2249-3379

How to cite this article: Deepak S, Nivedhitha MS. Comparison of coronal microleakage of three temporary restorative material using dye penetration methods. J Adv Pharm Edu Res 2017;7(3):232-235.

Source of Support: Nil, **Conflict of Interest:** None declared.

Zaia *et al.* tested microleakage of Coltosol, IRM, Vidrion R, and Scotch Bond temporary restorative materials using dye penetration method. IRM and Coltosol produced the better sealing ability whereas Scotch Bond showed highest microleakage.[14]

The purpose of this *in vitro* study was to compare the coronal seal of three temporary filling materials (Cavit-G, zinc oxide eugenol [ZOE], and IRM) by methylene blue dye penetration test.

Materials and Methods

A total of 34 caries free maxillary and mandibular molars which are extracted for periodontal reasons were stored in hydrogen peroxide for at least 2 h [Figure 1].

Endodontic access cavities of approximately 4 × 4 mm were accomplished with a #700 carbide bur (Dentsply Int. / Maillefer) [Figure 2]. After rinsing for 20 s with distilled water and air drying with oil-free compressed air for 20 s, a dry cotton pellet was placed on the floor of the pulp chamber. The periodental proble was used for measuring the depth of the cavity and at least 5 mm of temporary filling material was allowed [Figure 4].

The teeth were randomly divided into three groups of 10 teeth each [Figure 5]. Cavit-G was used in Group 1, ZOE in Group 2, and IRM in Group 3. All materials were mixed and handled according to the manufacturer's instructions.

The restorative materials were placed in increments and pressed against walls to ensure complete sealing. In addition to these groups, two positive and negative groups were also selected. Each group consisted of two teeth. Negative control group consisted of two healthy teeth with absence of any decay and obturation having healthy and intact crown, and access cavity was not prepared, and the positive control group consisted of 2 teeth with absence of any decay and obturation which access cavity was created but not filled with any restorative material with regard to the previous method.

Then, the teeth in separate groups were placed in normal saline for 2 hours to ensure the stiffness of the materials. Afterward, for preventing dye penetration, all the teeth surfaces (including root and crown) other than the occlusal surface were covered with two layers of nail polish [Figure 3].

The teeth were then placed in methylene blue liquid for 24 h. After which teeth were washed under running water for half an hour. For the longitudinal section of the teeth, diamond disc was used. Then, through making use of periodontal, dye penetration rate on the occlusal surface was measured, and the classiifcation of dye penetration rate is as follows:

Figure 1: 34 caries free maxillary and mandibular molar teeth were selected

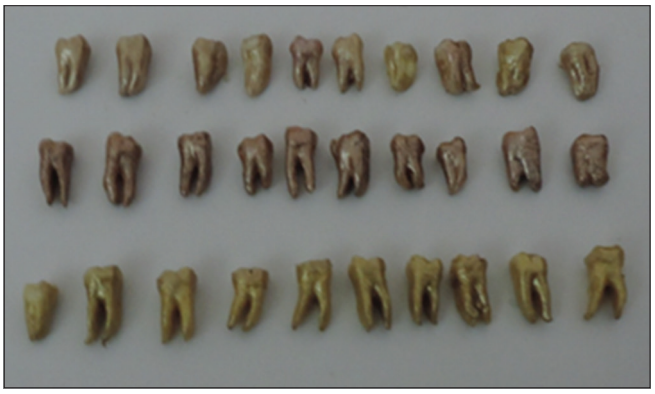


Figure 3: Apart from occlusal surface, all other surfaces were covered with two layers of nail polish to prevent dye penetration

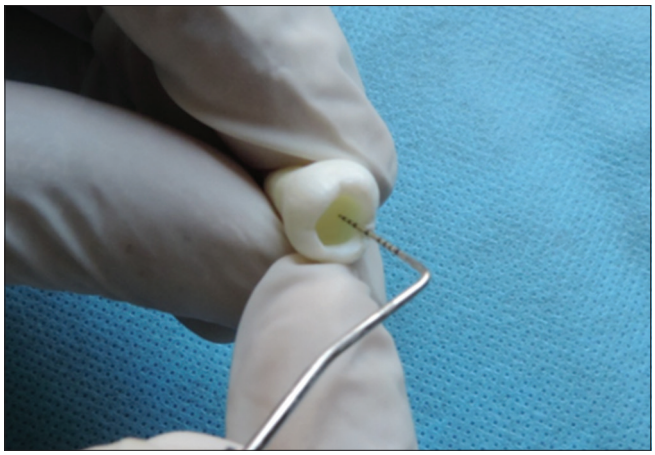


Figure 2: Endodontic access cavities of approximately 4 × 4 mm were made

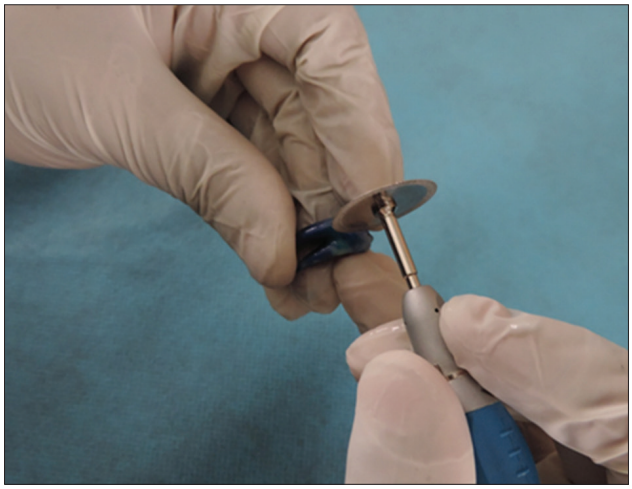


Figure 4: Longitudinal sectioning of teeth using diamond disc

- A: Degree 0 → without dye penetration
- B: Degree 1 → dye penetration up to (a depth of) 1 mm
- C: Degree 2 → dye penetration up to a depth of 2 mm
- D: Degree 3 → dye penetration up to a depth of 3 mm
- E: Degree 4 → dye penetration up to a depth of 4 mm
- F: Degree 5 → dye penetration of more than 4 mm.

Statistics

Statistical analysis was performed using the ANOVA test among all the groups. *Post hoc* turkey honest significant difference test was used for multiple comparisons at 95% confidence interval and $P = 0.05$.

Results

The results showed statistically significant differences in dye penetration among the groups. Groups 1 and 3 and 2 and 3 showed statistically significant difference in dye penetration. Groups 1 and 2 does not have significant difference [Table 1].

Negative control group does not show dye penetration whereas the positive control group showed complete dye penetration.

Discussion

In this research, the microleakage rate of the three materials - Cavit-G, IRM, and ZOE - was investigated with dye penetration where Cavit-G showed least dye penetration when compared to IRM and ZOE [Graph 1]. Webber *et al.*, Chohayeb and Bassiouny, Barkhordar and Stark, Lee *et al.*, Beckham *et al.*, and Pai *et al.* have used dye penetration method to evaluate the sealing ability of different temporary restorative materials.[3,5,6,14-16]

Different authors have reported conflicting results concerning the ability of Cavit and IRM to prevent coronal microleakage. Friedman *et al.*[17] and Blaney *et al.*[18] found that IRM showed better sealing ability than Cavit, whereas Marosky *et al.*,[19] Chohayeb and Bassiouny,[5] and Tamse *et al.*[20] favors Cavit-G. On the other hand, Marosky *et al.*[19] reported IRM had less leakage than polycarboxylate, whereas Turner *et al.*[21] concluded that both Cavit and IRM exhibited excellent sealing properties in comparison to polycarboxylate cement.

Our results demonstrated no statistically significant differences between Cavit and IRM. The main difference was that in IRM group, dye penetration was not only detected at the dentin filling interface but also found in the bulk of the material. This observation is different from Tamse *et al.*[20] who found dye penetration throughout the bulk of Cavit but not in IRM itself. According to previous reports, the behavior of IRM at the dentin-restorative interface may be affected by factors such as thermocycling[22] and the difficulty in handling the material.[19]

IRM seems to be more difficult to pack into an access cavity than other materials. The penetration of the dye in the bulk of the IRM may be caused by the presence of air bubbles and voids, which did not seem to affect the overall leakage patterns. These defects may be the result of mixing and insertion procedures. Cavit is a premixed, ready-to-use, hygroscopic material that expands when it comes in contact with moisture,[23] and presumably, this expansion permits the material to

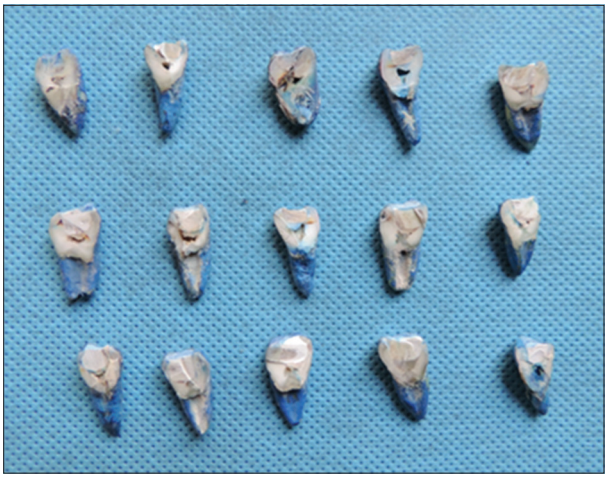
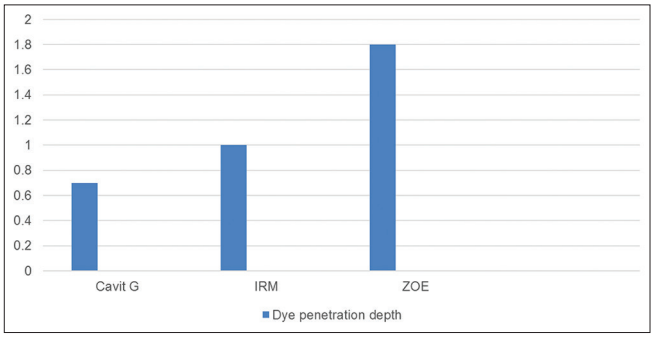


Figure 5: Dye penetration rate on the occlusal surface was measured using a periodontal probe



Graph 1: Comparison of dye penetration depth among Cavit-G, Intermediate Restorative Material and zinc oxide eugenol

Table 1: Comparison of dye penetration depth of three different temporary restorative material using *post hoc* Tukey HSD test

Dependent variable: Value Tukey HSD						
(I) group	(J) group	Mean difference (I-J)	Standard error	Significant	95% confidence interval	
					Lower bound	Upper bound
Cavit-G	IRM	−0.30000	0.26805	0.511	−0.9646	0.3646
	ZOE	−1.10000*	0.26805	0.001	−1.7646	−0.4354
IRM	Cavit-G	0.30000	0.26805	0.511	−0.3646	0.9646
	ZOE	−0.80000*	0.26805	0.016	−1.4646	−0.1354
ZOE	Cavit-G	1.10000*	0.26805	0.001	0.4354	1.7646
	IRM	0.80000*	0.26805	0.016	0.1354	1.4646

IRM: Intermediate Restorative Material, ZOE: Zinc oxide eugenol, HSD: Honest significant difference. *p<0.05

adapt more tightly to dentin walls, thus providing a good seal under different conditions, including thermocycling.[19-21,23]

Conclusion

According to the findings of the present *in vitro* study, low microleakage and canal contamination were found for Cavit-G and IRM temporary restorative materials in comparison to ZOE.

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